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HOME RANGE OF THE COTTONTAIL RABBIT

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Until recently, very few investigators have attempted to determine the home range of the cottontail rabbit. Seton ('29) states that unless a cottontail is driven afar by foxes or hounds, it probably spends its whole life within the limits of an acre. Goodwin ('35) maintains that a cottontail rarely strays more than a couple of hundred yards from home unless forced away. According to Dalke and Sime ('38), the Eastern cottontail in Connecticut utilizes ranges as follows: adult females, about 3 acres; and adult males 8.3 acres. Allen ('39) found that cottontails on the Kellogg farm (southwestern Michigan) apparently had winter ranges varying between 5 and 10 acres. He adds further that rabbits which occupied seemingly less favorable coverts, appeared to require more territory.

Range sizes given by Dalke and Sime apparently indicate the entire area on which a rabbit is active during the year. The studies of Allen, however, treat only of cottontail ranges during the period from November to March, inclusive. In each of the above investigations trapping was concentrated in areas where rabbit signs were most abundant. It is probable that the range found by such trapping methods will not correspond to the entire area occupied by each of the various individuals.

Home range data here recorded were secured during a two-year study (Jan. 1938-Dec. 1939) of the cottontail rabbit (*Sylvilagus floridanus mearnsii*) at the Swan Creek Wildlife Experiment Station, near Allegan, Michigan.

The study was made on six 160-acre sandy upland areas, each of which supported stands of second growth oak (*Quercus velutina* and *Q. alba*) and con-

tained one or more small open sites with a rank growth of wormwood (*Artemisia caudata*, figure 1). All study quadrats were located adjacent to an abrupt escarpment which separated the infertile upland and the adjacent fertile lowland. In general, most individuals were found on areas with a minimum of large-crowned trees, and with generous amounts of shrubby vegetation.

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TYPES OF INDIVIDUAL RANGES

The annual range of a cottontail can be divided into three seasonal ranges; namely, breeding season range, fall range, and winter range. These seasonal ranges usually do not correspond either in size or in locality. Burt ('40) defines the home range of an animal as "... that area about its established home which is traversed by the animal in its normal activities of food-gathering, mating, and caring for young." The term "home range" is used in a similar sense in this paper. Most home ranges determined during this investigation are based on the area utilized by the individual cottontails during a period of from 2 weeks to a month. Both Stoddard ('31), who was working with bobwhite, and Burt, who studied several species of small rodents, recognized that animals shift their range from time to time. The seasonal range of an individual accordingly consists of the aggregate area of the home ranges

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FIG. 1. A successful trapping station in typical upland cover much used by cottontails during summer. Oak reproduction in background, wormwood in foreground.

which that individual utilizes during that season.

Breeding season ranges are shown by this study to be distributed rather uniformly on all areas with suitable food and cover. During the fall period immature rabbits frequently disperse and occupy new areas. The ranges occupied by adult cottontails during fall are frequently shifted as a result of the cessation of sexual activity, and because of destruction of annual vegetation by frosts. Most rabbits which occupied ranges on the upland adjacent to the escarpment migrated to the lowland during winter (fig. 2).

METHOD OF DETERMINING SIZE OF HOME RANGE

The home range requirements of the cottontail has been studied by live-trapping at permanent trap stations which were geometrically located (grid pattern) at 110-yard intervals. With this spacing of traps, each trap location is surrounded by a 2.5-acre square of land which is closer to that trap station than to any other trap station (fig. 3). In each study

area, there are 49 such contiguous 2.5-acre trap squares, each with a trap location at its center.

On the average, it is statistically correct to assume that when a rabbit is taken at any one of the trap stations arranged as above, its range occupies the surrounding area equal to half the distance to the nearest traps (2.5 acres). The area ranged over by a single individual, however, may not necessarily agree with this assumption. If a rabbit is taken in 2 adjoining trap stations, then it is proper to assume that on an average such an individual occupies all of both squares (5 acres), or if an individual be taken in two trap stations which are not adjacent, then it can be assumed that on an average that individual will occupy the two trap squares, plus all intervening trap squares. It may also be assumed that a rabbit taken at three or more trap stations, will on the average occupy areas equal to the sum of all the 2.5-acre trap squares in which the given individual is taken plus the sum of all intervening 2.5-acre trap squares in which it was not captured (fig. 3).



FIG. 2. Leather leaf bog. One of the lowland habitats to which many of the cottontails from the adjacent upland repair during winter.

.	.	.	.	.	.	B.
.	A.	.	.	.	B.	.
.	.	A.	.	.	B.	.
.	.	.	.	.	.	.
.	A.	.	C.	.	.	.
.	.	.	.	C.	.	C.
.	.	.	C.	.	.	C.

FIG. 3. Outlines of 3 hypothetical home ranges, illustrating method for calculating areas. Each square is 2.5 acres in area and has a trap station at its center. Letters represent point of capture of individuals.

NUMBER OF CAPTURES NECESSARY TO
SHOW SIZE OF HOME RANGE

The known range of a rabbit when determined by the above method, will increase as the number of captures increases, until the indicated or known

range equals the area actually occupied by the rabbit. Further captures thereafter will fail to add to the range of the individual.

Application of the method is illustrated by the records of two breeding females. Female No. 449 (pregnant) was handled 22 times during May and July, 1939. Captures of this doe have been numbered in the sequence in which she was taken, and are shown in figure 4 and graph 1. Consecutive captures of this female in parts of her range indicate a steady increase in size of known range until the 12th capture (graph 1). Therefore, the entire home range of this female was demonstrated on the 12th capture (25 acres). The records of female No. 454 show that her entire home range of 22.5 acres was demonstrated on the 11th capture.

The number of captures necessary to show the entire home range of individual rabbits has been found to vary with age and sex of the individual, as well as with the season. Therefore, it is necessary that some method be used to evaluate the reliability of a group of indicated home ranges, before a significant average home

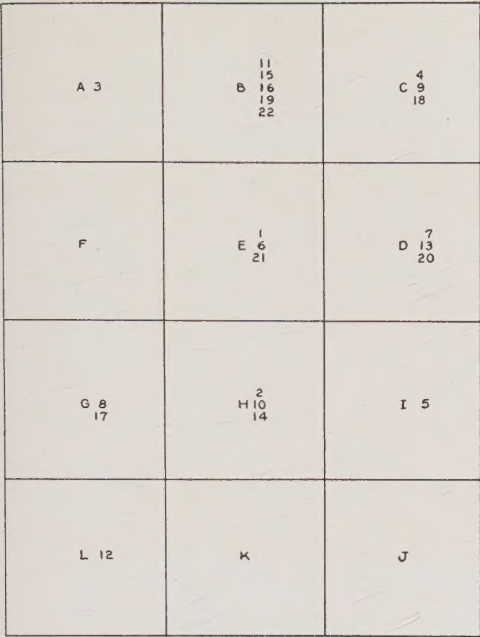
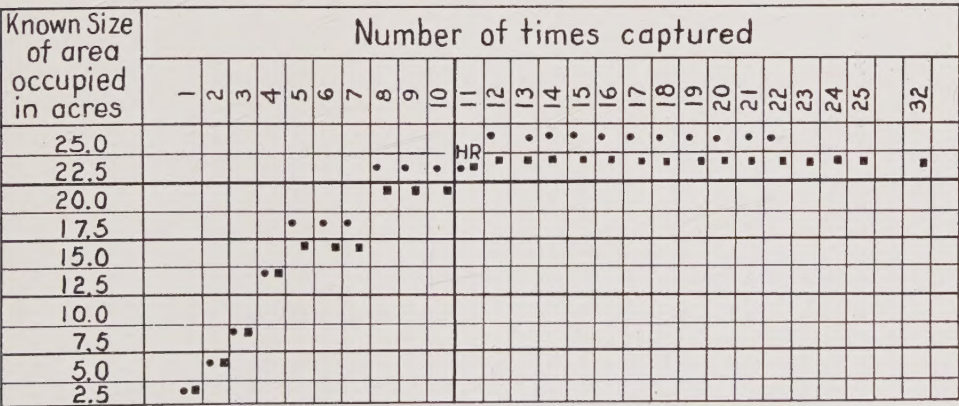


FIG. 4. Sequence and points of capture of adult breeding female No. 449 during breeding season. Each square is 2.5 acres in area and 110 yards on a side. Captures 1 to 5 taken between May 13-22, and captures 6 to 22 taken between July 11-29. Letters denote trap stations.

range area can be determined. A tabulation of individual cottontail home ranges according to size, and the number of captures necessary to determine that size, can be used as an aid in sorting out complete ranges from those which are inadequately shown. The average size of the group of known ranges can then be determined from the apparently complete ranges.

Adult female ranges in table I, which are determined by less than 9 captures, seem incomplete because the known sizes increase progressively with increase in number of captures from which calculated. From the 9th capture on, however, the average size of the ranges no longer progressively enlarges, but continues about the same (table I). It is reasonable, therefore, to assume that the minimum number of captures necessary to determine average size of individual home ranges of this group of adult females is nine. Accordingly, only home ranges of adult females determined from 9 or more captures, have been used in computing average size. Home ranges determined by this method will be larger in average size than will



GRAPH 1. Relation between number of captures and known size of area ranged over (2 adult breeding females).

Key:
● Trapping records of female No. 449.
■ Trapping records of female No. 454.
H.R. Point at which the home ranges of these females were adequately shown.

TABLE I. Size of area ranged over by adult female cottontails during the breeding season

Size of area occupied in acres	Number of captures																			Total individuals rabbits						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		20	21	22	23	29	
	Number of individuals taken																									
42.5	1*																									1
40.0																										
37.5																										
35.0																										
32.5																										
30.0																										
27.5																										
25.0																										
22.5																										
20.0																										
17.5																										
15.0																										
12.5																										
10.0																										
7.5																										
5.0																										
2.5																										
Number areas	13	6	5	8	3	4	2	5	2	2	2	2	2	2	1	2	1	1	1	1	1	1	1	60		
Mean area in acres	2.5	4.6	7.0	10.6	15.8	11.3	12.5	14.0	21.3	21.3		21.3		42.5*	20.0			27.5	22.5	25.0	15.0	30.0				
	Average size of complete home ranges 22.5 acres																									
	Ranges apparently incomplete																									

* True home range size is probably 27.5 acres. Not included in average.

ranges determined by the methods of Blair ('40), Burt ('40), Allen ('39) and others.

The small number of home ranges which were adequately determined makes it impossible to evaluate the effect of local population density on the size of range. During the study, the average cottontail population of the 960 acres varied from one animal per 10 quadrat acres during fall to one animal per 17 quadrat acres during spring (Haugen, ms.).

It is possible that a rabbit might develop a trap habit, and consequently fail to visit regularly all parts of its home range. In such a case, a greater number of captures than normal would be required to show the size of an individual's home range. However, there is no indication that any adult rabbit handled in this study had formed such a habit.

SIZE OF HOME RANGE

Size of Home Range of Adult Female Cottontails During Breeding Season

Only about one-fourth of the 60 adult females taken during the breeding season were captured a sufficient number of times (9 or more) to determine the entire area of their home ranges. All except one of the 14 home ranges which are based on 9 or more captures are from 10 to 30 acres in size (table I). The single exception is one 42.5-acre range, of which 15 acres were added by a single capture at a trap

one-fourth mile from the female's usual range. During the year she was taken 14 times on an area 27.5 acres in size, but was never retaken near the single remote point of capture. Perhaps she had been driven there by some predator, or may have wandered this distance for some other unknown reason. This single large range is therefore not included in computing the average size of home range of adult females.

Thirteen of the home ranges based on 9 or more captures are apparently adequately determined. The average size of these 13 adult females' home ranges is 22.5 acres.

Size of Home Range of Adult Female Cottontails During Fall

Only one individual female cottontail was captured a sufficient number of times in the fall to show its entire home range at that season (table II). This female was taken 12 times on an area 15 acres in extent. The average fall home range of adult female cottontails is probably larger than the 15-acre size shown by this single female.

Size of Home Range of Female Cottontails During Winter

During winter 5 of the 14 females taken were captured a sufficient number of times to determine their entire home ranges.

TABLE II. *Size of area ranged over by adult female cottontails during fall*

Size of area occupied in acres	Number of captures													Total individual rabbits
	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Number individuals taken													
17.5														
15.0			1	1								1		3
12.5				1										1
10.0			1	1										2
7.5		1	2											3
5.0		1												1
2.5	9													9
Number areas	9	2	4	3								1		19
Mean area in acres	2.5	6.3	10.0	12.5								15.0		
	Ranges apparently incomplete						Size of complete range 15 acres							

Size of Home Range of Adult Male Cottontails During Breeding Season

There is no indication that the breeding season home range of any one of 76 males handled has been adequately determined. The area ranged over by males appears to enlarge indefinitely as the number of captures increases (table IV). This apparently constant increase in range size as the number of captures increases, indicates that adult breeding males roam considerably, perhaps over a very large range, which may be a hundred acres or more in extent. It is not uncommon for a breeding male to be taken at points one-half mile apart. Males, however, do not wander about aimlessly, because they reappear at the same trap stations from time to time. One male which was trapped nine times during the breeding season, was found to occupy a roughly crescent-shaped area three-fourths of a mile long. Two captures were made at each extreme of this large range.

Size of Home Range of Adult Male Cottontails During Fall

An average home range size cannot be determined from available data for adult males during the fall, because the 23 males taken were not recaptured enough times to show their complete ranges. Indications are, however, that the average lies somewhere above 10 acres (table V).

Size of Home Range of Male Cottontails During Winter

Not one of the 19 males taken during the winter was captured a sufficient number of times to determine the size of an entire home range. The rate of increase in size of the area ranged over per additional capture of males is not as great during winter as it was during the breeding season (tables IV and VI). This indicates that males roam less widely during winter, then they do during the breeding season. A smaller range during winter may be due to localized activity,

TABLE V. *Size of area ranged over by adult male cottontails during fall*

Size of area occupied in acres	Number of captures								Total individual rabbits
	1	2	3	4	5	6	7	8	
	Number of individuals taken								
15.0									
12.5	1								1
10.0	11								2
7.5									
5.0	2								2
2.5	18								18
Number areas	18	3		1	1				23
Mean area in acres	2.5	6.6		12.5	10.0				
	All ranges apparently incomplete								

and to the fact that mature males born the previous season may occupy a smaller area than do the veteran bucks.

Size of Home Range of Juvenile Cottontails During Breeding Season

Young rabbits when first out of the nest probably have a very small home range. It is, therefore, to be expected that they will usually be captured at only one or sometimes two trap stations when they first begin to shift for themselves. Young which are about one-third grown (about 1 lb.) frequently reenter the same trap. When such young are taken 8 or 10 times at a single trap station, it is likely that they have developed a trap-habit. In a few such cases, it has been necessary to leave a trap closed for a few days to break such an immature individual of its trap-habit at that station.

An unusually large range of a juvenile, when based on few captures, may not indicate the animal's actual home range, but may be indicative of dispersal. This seems to be true of the individual which was trapped 7 times on an area 55 acres in extent (table VII). This young rabbit after being taken several times at one locality was a short time later retaken at a location three-fourths of a mile distant.

TABLE VI. *Size of area ranged over by adult male cottontails during winter*

Size of area occupied in acres	Number of captures											Total individual rabbits
	1	2	3	4	5	6	7	8	9	10	11	
	Number of individuals taken											
40.0											1	1
37.5												
35.0												
32.5												
30.0												
27.5												
25.0												
22.5						1	1					1
20.0					1	1						2
17.5												
15.0						1						1
12.5		1						1				2
10.0			1									1
7.5		1	1									2
5.0		3										3
2.5	6											6
Number areas	6	5	2		1	3	1				1	19
Mean area in acres	2.5	7.0	8.8		20.0	19.2	12.5				40.0	
	All ranges apparently incomplete											

TABLE VII. *Size of area ranged over by juvenile cottontails during the breeding season*

Size of area occupied in acres	Number of captures																			Total individual rabbits				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19					
	Number individuals taken																							
55.0					1*															1				
52.5																								
50.0																								
47.5																								
45.0																								
42.5																								
40.0																								
37.5																								
35.0																								
32.5																								
30.0																								
27.5																								
25.0																								
22.5	1																			1				
20.0																								
17.5					1																			2
15.0					1				1				1				1				9			
12.5	3				1				1				1				1				9			
10.0					3				3				1				1				13			
7.5	4				8				6												29			
5.0	14				11				7												46			
2.5	53				12				10				1								83			
Number areas	53	34	31	16	14	8	13	3	4	4	1	3	1		1	1	3	1	2	193				
Mean area in acres	2.5	5.6	5.5	6.6	8.3	8.8	12.3	10.8	6.3	5.0	2.5	9.2	10.0		12.5	10.0	8.3	12.5	12.5					
	Incomplete ranges†				Average size of complete ranges 9.3 acres																			

* Emigrant. Not included in average.
† Part of these ranges may be complete, however, they can not be distinguished from the incomplete ones.
‡ Not included in average because the individuals occupying these areas had formed a trap-habit or were only partly resident in areas trapped.

It is likely that this individual emigrated or moved its home range from the locality it first occupied.

The home ranges of juvenile rabbits which were captured 5 or more times are apparently adequately determined (table VII), except for those ranges which were only 2.5 acres in extent. Most of these 2.5-acre ranges were evidently due to trap-habit, or were located at a borderline trap station; accordingly, they have been omitted in calculating average range. About one-third of the 193 juvenile rabbits taken during breeding season were captured a sufficient number of times to determine their home range.

Average size of home range of 51 juveniles during the breeding season is 9.3 acres. However, because of the wide difference in age of successive litters, the home range probably varies in size from zero at the time the young are in the nest, to 15 acres before dispersal takes place.

Size of Home Range of Juvenile Cotton-tails During Fall

Males. During the fall ten juvenile males were captured a sufficient number of times to adequately determine size of their home range at this season. These

home ranges, which vary in size from 7.5 to 20 acres (table VIII), have an average size of 13.5 acres.

Females. During the fall six juvenile females were handled a sufficient number of times to show their home range size. Size of the home range at this season varied from 10 to 20 acres (table IX), with an average of 14.6 acres.

The 25-acre range indicated by only 2 captures (table IX) of one animal probably represents the area traversed by the rabbit during dispersal. This individual was taken only once at each of two traps set one-half mile apart. This range was accordingly not included in computing the average range size for juvenile females.

Both sexes of immature rabbits, therefore, appear to have ranges approximately similar in size during the fall period, between 13 and 15 acres.

TERRITORY

Home ranges of individual rabbits often overlap. The amount of overlapping of adjacent home ranges varies considerably among individuals of the rabbit population, depending upon both sex and age. It is to be expected that ranges of females should overlap those of males

TABLE VIII. *Size of area ranged over by juvenile male cottontails during fall*

Size of area occupied in acres	Number of captures																	Total individual rabbits	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
	Number individuals taken																		
20.0							1					1						2	
17.5				1	1								1					3	
15.0				1			1	1										3	
12.5				1	2					1								4	
10.0		3	2	1		2												8	
7.5		4	1	2				1									1	9	
5.0		13	2															16	
2.5	39	3																42	
Number areas	39	23	8	6	1		3	2	1	1		1	1				1	87	
Mean area in acres	2.5	5.7	10.3	9.6	5.0		11.7	17.5	7.5	12.5		20.0	17.5				7.5		
	Incomplete ranges					Average size of complete home ranges 13.5 acres													

TABLE IX. *Size of area ranged over by juvenile female cottontails during fall*

Size of area occupied in acres	Number of captures												Total individual rabbits
	1	2	3	4	5	6	7	8	9	10	11	12	
	Number individuals taken												
25.0	1*												1
22.5						1							1
20.0											1		1
17.5						2							5
15.0						1							5
12.5													8
10.0									1				16
7.5													11
5.0													33
2.5	32	1											
Number areas	32	21	9	12	1	4	1					1	81
Mean area in acres	2.5	8.1	9.2	12.0	12.5	15.6	10.0					15.0	
	Ranges apparently incomplete					Average size of complete home ranges 14.6 acres							

* Probably represents area traversed by the rabbit during dispersal.

and juveniles. However, it does not follow that two or more breeding adult females should occupy a common range, or that a breeding adult male should tolerate the presence of a second adult male within its cruising radius.

The interrelationship of the home ranges of the adult cottontails which occupied the Stocking Area (160 acres) during the 1939 breeding season has been determined. Several females were each found to be pregnant four times on this area during the 1939 breeding season. It is therefore believed that this area is particularly suitable for illustrating the relationships of the home ranges of adult rabbits during the reproductive season.

Territorial Behavior of Female Cottontails

The interrelationship of the ranges of 11 adult females which were taken on the Stocking Area during the 1939 breeding season indicates territorial behavior among females. The areas occupied by most of these females were for the most part separate and distinct from the areas occupied by other breeding females. The

only overlapping of ranges noted occurred along the edges of the ranges. Female No. 821, whose range overlaps that of female No. 163 (fig. 5), is a vagrant re-

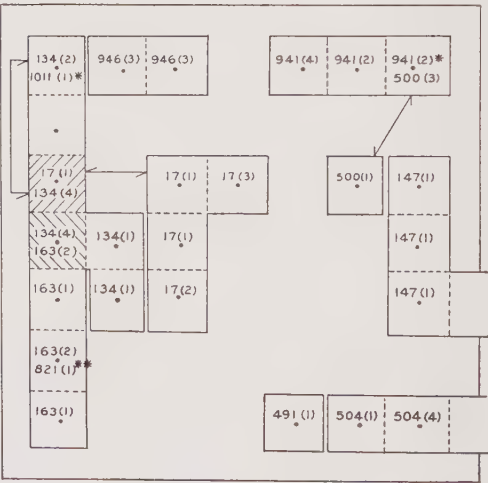


FIG. 5. Trap squares in which numbered adult female cottontails were trapped during the breeding season of 1939. The number of times an individual was taken in each square is indicated in the parentheses.

*—No conflict until Aug. 11 or later.
**—Emigrant.
Cross hatch—overlapping of female ranges.

stocked animal which did not remain on the area. Similarly Allen ('39) has shown that of 7 rabbits transplanted onto an area, only one rabbit remained at the point of liberation, others disappeared, emigrated, or seemed to wander. Except for the range of female No. 134, which has some part of its indicated range overlapping that of three other females' ranges, overlapping of home ranges appears to occur at only one trap station. Overlap of the ranges of females 941 and 500, and the overlap of the ranges of females 1011 and 134, did not occur until the middle of August, at which time the breeding season was approaching its end. Female No. 17 was taken in the same trap as was female No. 134, but this trap location is rather remote (see figure 5) from the main part of the home range of female No. 17, and may therefore not represent part of her usual territory.

From evidence found on this 160-acre quadrat, on which 11 adult females were taken 66 times during the 1939 breeding season (fig. 5), there appears to be only one certain overlap between the home ranges of two adult females. It seems reasonable to assume, therefore, that breeding female cottontails on this area were defending their home ranges, and not tolerating the presence of other breeding females. At no time was a cottontail seen to drive another cottontail from a certain area. Linsdale ('38) while watching two jack rabbits (*Lepus californicus*) on May 19, saw one of the individuals lay its ears back and dash at the other, which then left that neighborhood. Howard ('20) and Heape ('31) have shown that some species of birds and mammals possess territories which they defend as their own, but may associate freely with other members of the same sex on adjacent neutral grounds. If female cottontails defend individual territories, then the home range in at least one case was slightly larger than the territory defended as a nesting site.

Gordon ('36) found that an adult *Callospermophilus lateralis lateralis*, which

lived with 5 young in a log pile, defended the pile and its immediate vicinity, but when she was more than 100 feet away, she seemed quite indifferent to other individuals. Apparently the territory defended by this adult squirrel was smaller than its home range. Burt ('40) states that the home range and the territory defended by the deer mouse *Peromyscus leucopus noveboracensis* is about the same.

The known home ranges of 63 adult female cottontails taken on all management study areas (960 acres) during the breeding season did not overlap. An additional 31 home ranges overlapped, usually at a single trap station. The relationships of these 94 adult female ranges were, however, usually determined for a single period of only 2 to 3 weeks. Accordingly, this supplementary information on territorial behavior of breeding females is not as dependable as the information secured by the previously discussed intensive study of the interrelationship of home ranges of breeding females on the Stocking Area.

Territorial behavior of adult female cottontails seems to continue into the fall and winter. Eighty-six per cent of the 14 known adult female fall ranges, and 83 per cent of the 12 winter ranges determined, did not overlap (conflict) in location. Due to mortality, the population density of adult females is considerably smaller at this season. Also, remaining females are apparently less easily captured during the fall than they were during the breeding season, with the result that most home ranges of females were inadequately determined during fall. Accordingly, it is conceivable that the small amount of overlapping of adult female home ranges during fall and winter, may be due either to defense of territory, to inadequacy of the data relating to fall ranges, or to the small chance that the home ranges of the sparse population of females might overlap. Allen ('39) found that the winter ranges of cottontails on the Kellogg farm in southwestern Michigan overlapped indiscriminately.

females overlap, the overlap usually occurs at only a single trap station, indicating the possibility that the areas defended as a territory may be bordered by strips of neutral ground. The ranges of males may overlap the ranges of females, or other males, indiscriminately.

LITERATURE CITED

- Allen, D. L.** 1938. Ecological studies on the vertebrate fauna of a 500-acre farm in Kalamazoo County, Michigan. *Ecol. Mon.*, **8**: 347-436.
- . 1939. Michigan cottontails in winter. *Jour. Wildlife Management*, **3**: 307-322.
- Blair, W. Frank.** 1940. Home ranges and populations of the meadow vole in southern Michigan. *Jour. Wildlife Management*, **4**: 149-161.
- Burt, William Henry.** 1940. Territorial behavior and populations of some small mammals in southern Michigan. *Univ. Michigan, Mus. Zool. Misc. Pub.* 45.
- Dalke, Paul D., and Palmer R. Sime.** 1938. Home and seasonal ranges of the eastern cottontail in Connecticut. *Third North Am. Wildlife Conf. Trans.*, 659-669.
- Goodwin, George Gilbert.** 1935. The mammals of Connecticut. *State Bulletin No.* 53, 221 pp.
- Gordon, Kenneth.** 1936. Territorial behavior and social dominance among Sciuridae. *Jour. Mammalogy*, **17**: 171-172.
- Haugen, Arnold O.** Management studies of the cottontail rabbit in southwestern Michigan. Unpublished manuscript, 97 pp.
- Heape, Walter.** 1931. Emigration, migration and nomadism. Cambridge. W. Heffner & Sons Ltd. Pp. 369.
- Howard, H. Eliot.** 1920. Territory in bird life. London: John Murray. Pp. 308.
- Linsdale, Jean M.** 1938. Environmental responses of vertebrates in the Great Basin. *Amer. Midl. Nat.*, **19** (1): 1-206.
- Seton, E. T.** 1929. Lives of game animals. New York. Doubleday, Doran & Co., 4 vol.
- Stoddard, Herbert L.** 1931. The bobwhite quail, its habits, preservation and increase. New York. Chas. Scribner's Sons. Pp. 559.

